Use of computed microtomography to investigate the microstructure of soil aggregates

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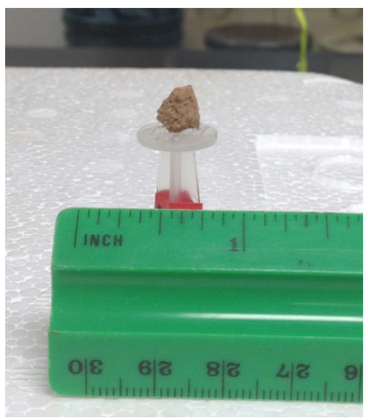
Introduction

- Requirements for high yields while maintaining long term agricultural soil sustainability are necessitating a better understanding of soil aggregate scale processes.
- Just like a doctor uses a medical CT 3D gray scale image to diagnose *in situ* and non-destructively certain medical conditions, computed microtomography (µCT) allows for the *in situ* and non-destructive analysis of soil aggregates.
- Gray scale values in images correspond to different structural components of soil aggregates. Voids and organic material have lower (darker) gray scale values, while mineral components have higher (lighter) gray scale values.

Experimental Procedure

Figure 1: Aggregates (top) are mounted and place in the x-ray beam. Non-absorbed x-rays are converted to visible light and captured with a camera.



Results

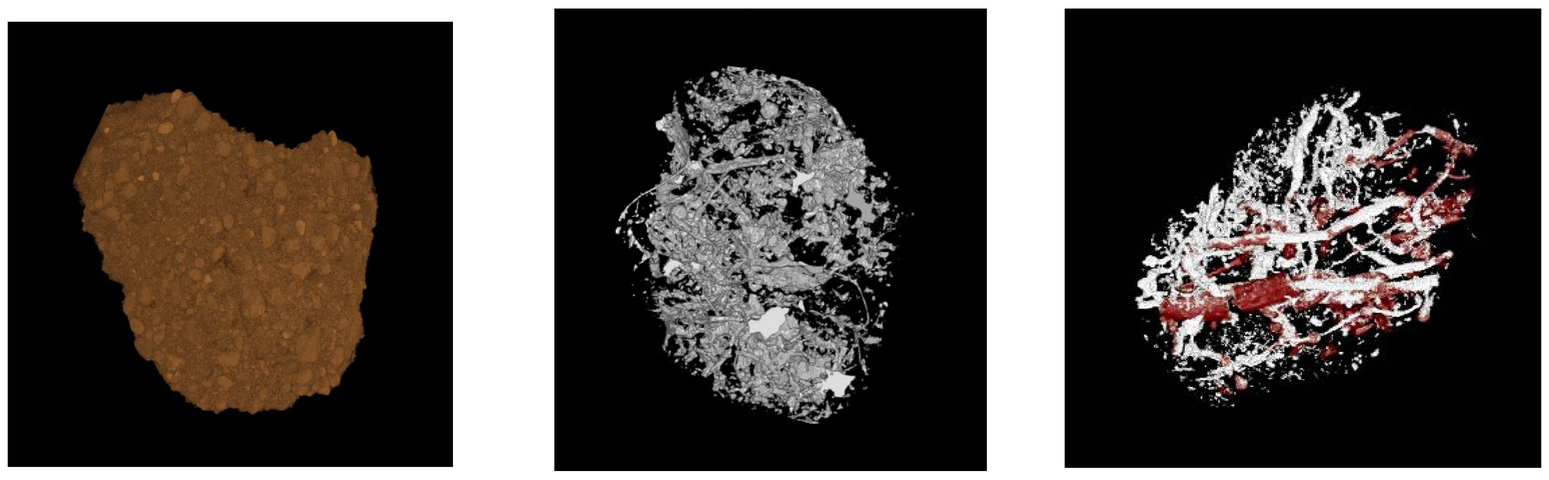


Figure 2: A complete 3D image of a soil aggregate (left), a 3D image of identified pores within a soil aggregate (middle), and a 3D image of identified pores (white) and particulate organic matter (red, right).

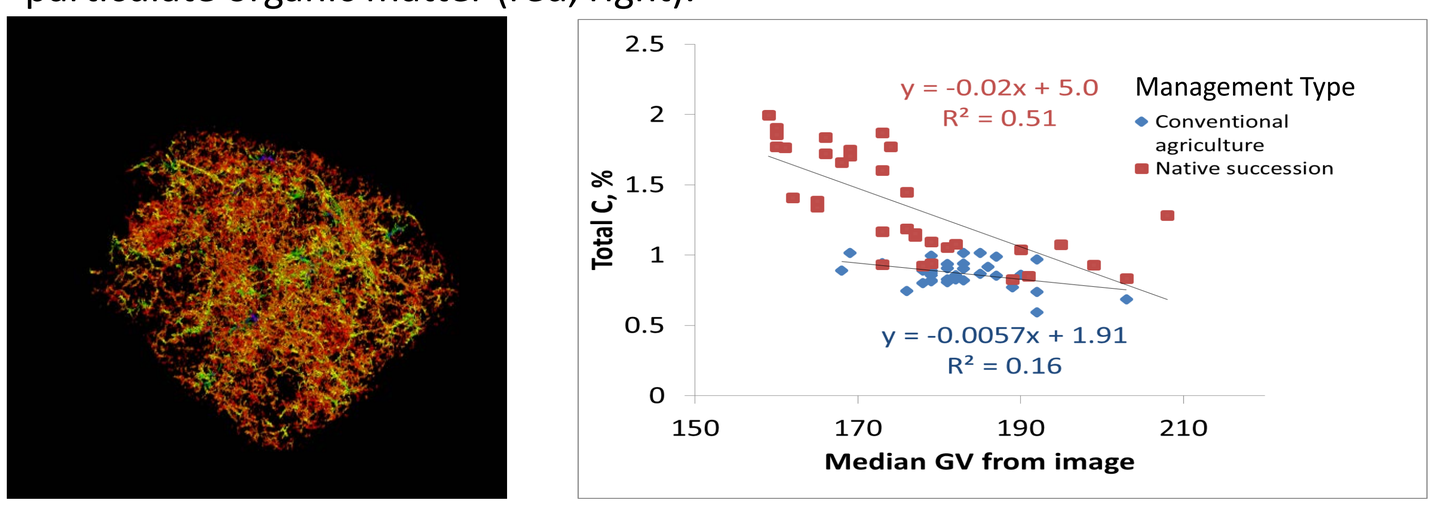


Figure 3: 3D image of soil pores with colors denoting pores size (red=small, blue=large, left image). Initial results showing correlation between gray scale values (GV) and lab measured % total carbon (right, from M.S. thesis of K. Ananyeva (MSU, 2012)).

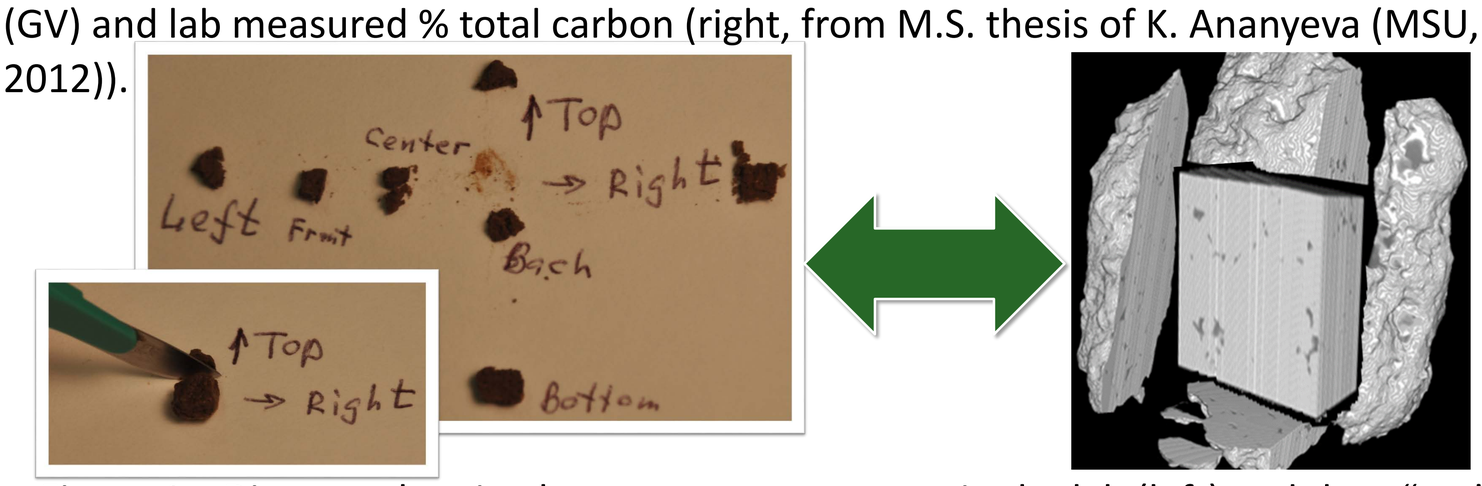


Figure 4: Diagram showing how aggregates are cut in the lab (left) and then "cut" as an image (right) to correlate image properties to lab measurements (see Figure 3).

Conclusions and Recommendations

- µCT allows observations of soil aggregates at micron scale
- Micro-scale observations can be related to macro-scale observations to elucidate micro-scale causes of macro-scale phenomena, leading to better management

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